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AUTHOR Kramer, Ronald C.; Jaksa, James A.
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ABSTRACT

Arguing that the issue of organizational decision making and bureaucratic responsibility in the use of technologies with potential for creating social harm should concern everyone, this paper explores the ethical issues raised by organizational decisions concerning the launch of the space shuttle "Challenger." The paper first describes a theoretical approach to organizational deviance--factors that cause people to act in deviant ways--then uses this perspective to develop a model for understanding organizational deviance. The major portion of the paper applies this model to the "Challenger" tragedy, observing that while the technical cause of the explosion was the failure of a pressure seal, the more important cause was the flawed decision-making process at the National Aeronautics and Space Administration (NASA). The paper concludes with a list of six general observations concerning the making of ethical decisions: (1) the effects of an individual's actions, communication, or failure to communicate can be assessed as a means of making ethical judgments; (2) persons who accept major decision-making roles must be held to standards that represent careful, rational, and objective decision-making processes; (3) the responsibility of assuring that information will flow in an organization is largely that of top management; (4) an ethic of "care" mandates that persons in authority be concerned about the effects of their actions on human beings; (5) sensitivity to and awareness of ethics should be increased; and (6) whistle blowing and bypassing the usual channels of communication are ethical decisions and put a heavy weight of responsibility on persons who do not speak out. (Forty-five references are included.) (FL)

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THE SPACE SHUTTLE DISASTER: ETHICAL ISSUES IN ORGANIZATIONAL DECISION-MAKING

Ronald C. Kramer
and
James A. Jaksa

Western Michigan University

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THE SPACE SHUTTLE DISASTER:
ETHICAL ISSUES IN ORGANIZATIONAL DECISION-MAKING

As people heard about the explosion of the space shuttle Challenger on January 28, 1986, and the deaths of its seven crew members, one of the most common reactions was disbelief. The launching of a space shuttle had become routine and few people could believe that such a tragedy as this was possible. Concern soon focused on the "cause" of this terrible accident. A Presidential Commission was appointed to investigate the Challenger disaster and discover that cause. As the Roger's Commission began its work, most people assumed that some technical malfunction was responsible for the accident. What the Roger's Commission found, however, raises serious questions about the ethical content of organizational decision-making in a world dominated by large corporate actors and exposed to enormous technological harms.

The Roger's Commission (1986) was able to identify the technical cause of the explosion of the Challenger: burnthrough of the solid rocker booster joint O-rings. The Commission also found that the decision-making process at NASA was flawed in several ways and was a contributing cause of the space shuttle disaster. Thus, the explosion of the Challenger was not just an accident - unforeseen, unexpected, a chance happening - it was an act of organizational deviance. Individuals in structural positions within the organization made decisions that resulted in the death of seven people and violated normative expectations concerning safety in the use of complex technology. The issue of organizational decision-making and bureaucratic responsibility in the use of technologies that have enormous potential for creating social harm ought to concern all of us, especially in the wake of Chernobyl and Bhopal. The purpose of the paper is to explore the ethical issues raised by the organizational decisions concerning the space shuttle

Challenger. Before we can discuss these ethical issues, however, we need to develop a greater theoretical understanding of the space shuttle disaster from an organizational deviance perspective.

A Theoretical Approach to Organizational Deviance

The focus of work in the sociology of deviance, traditionally, has been on individuals who have violated widely shared normative expectations. The theoretical concern has been to discover the factors that cause people to act in deviant ways. A wide variety of "images of deviance" have been created by theorists working in this field (Pfohl, 1985).

This traditional individualistic focus has been challenged in recent years by a number of sociologists intent on developing an organizational deviance perspective (Reiss, 1966; Wheeler, 1976; Shover, 1978; Ermann and Lundman, 1978;Schrager and Short, 1978; Gross, 1978; 1980). The organizational deviance perspective is grounded in two underlying assumptions. The first assumption is that complex, formal organizations are social actors in their own right and, therefore, are an appropriate unit of analysis in the sociology of deviance. The second assumption is that the deviant acts of organizations are causally related to the bureaucratic structure, formal goals and external environment of those organizations.

For a variety of reasons, it appears that the first assumption is easier to make than the second. Thus, you have the situation in which organizational forms of deviance are explained by social psychological theories that focus on individuals within the organization. This tendency within the field can be traced to the influential work of Edwin Sutherland on the topic of white collar crime.

Sutherland (1949) carried out the first empirical study of organizational crime. He reviewed the records of seventy large corporations and found that each corporation had engaged in at least one illegal action. Sutherland (1949:234) attempted to explain these organizational violations through his theory of differential association:

> The data which are at hand suggest that white collar crime has its genesis in the same general process as other criminal behavior, namely, differential association. The hypothesis of differential association is that criminal behavior is learned in association with those who define such behavior favorably and in isolation from those who define it unfavorably, and that a person in an appropriate situation engages in such criminal behavior if, and only if, the weight of the favorable definitions exceeds the weight of the unfavorable definitions.

Sutherland had developed differential association theory in the 1930s to explain traditional forms of crime and delinquency. When he turned his attention to white collar crime and began researching the crimes of corporate organizations, he simply extended his social psychological learning theory to corporate executives. Other research on corporate crime found support for the theory of differential association (Clinard, 1946; Lane, 1953; Geis, 1967).

While there can be no doubt that important insights have been derived from this line of analysis, some sociologists criticized this theoretical approach for ignoring the organizational level of analysis. These critics argued that corporate crime is organizational crime and therefore requires an organizational level of analysis. Theories which focus only on social psychological variables, they contended, cannot adequately explain why corporate organizations as social entities violate the law. As Schrager and Short (1978:410) point out:

> Preoccupation with individuals can lead us to underestimate the pressures within society and organizational structure, which impel those individuals to commit illegal acts ... These difficulties make

> necessary and possible the analysis of organizations as potentially criminal agents. Recognizing that structural forces influence the commission of these offenses does not negate the importance of interaction between individuals and these forces nor does it deny that individuals are involved in the commission of illegal organizational acts. It serves to emphasize organizational as opposed to individual etiological factors, and calls for macrosociological rather than an individual level of explanation.

The organizational deviance perspective, therefore, assumes that not only are organizations the primary unit of analysis, but that an organizational and macro-sociological level of analysis must also be used to explain the deviant acts of organizations. These theorists do not deny that individuals make up an organization. But they argue that organizational factors determine how these individuals within the organization will act. As Ermann and Lundman (1982:67) note:

> People within organizations act in certain ways because they occupy positions that train them to act in certain ways and constrain them from acting otherwise. Organizationally, beneficial thoughts and actions are forced upon individuals by virtue of the position they occupy. If individuals holding positions do not behave according to the expectations associated with these positions, they will be replaced.

Hall (1977:26) has made a similar argument with regard to organizational decision making:

> Many decisions in organizations ... are organizational decision. That is, the organization has set the parameters for decision making and the individual simply follows the procedures that have been prescribed for him. These rather programmed types of decisions are usually at a low level. But more important decisions about future organizational directions and policies are also strongly influenced by organizational factors. The whole area of tradition and precedent, power position within the organization, and the organization's relationship with its environment have an impact on how individuals within the organizational hierarchy make decisions on behalf of the organization. Organizational considerations thus pervade the decision-making process.

In recent years, a number of important theoretical contributions have been made to the study of organizational deviance (Albanese, 1982; Barnet, 1981; Clinard and Yeager, 1980; Ermann and Lundman, 1982; Finney and Lesieur, 1982; Gross, 1978, 1980; Kramer, 1982; Vaughan, 1982). These theoretical efforts attempt to identify the organizational dynamics and macro-sociological conditions that give rise to the deviant acts of complex organizations. Based on this work, it is now possible to pull together a general theoretical model which can be used to understand organizational deviance in general, and the space shuttle disaster in particular. The remainder of this section will outline the general model and in the following section it will be applied to the Challenger case.

There are three major elements or stages in the model: 1) the formal goals of the organization and the performance pressure associated with them, 2) the structural strain that can arise from a disjunction between prescribed goals and the legitimate available means, and 3) the operationality of controls over organizational behavior. Each of these elements can be explained at two analytically distinct organizational levels: 1) at the intersection of the internal organizational structure and the external environment, and 2) at the intersection of the internal organizational structure and the individuals who occupy positions within that structure. The model can be diagramed in the following way.

Theoretical Model to use in Explaining Organizational Deviance

Analytical Levels	Operative Goals: Performance Emphasis	Structural Strain: Available Means	Operationality of Social Controls
External Environment			
Internal Structure			
Internal Structure			
Individual Agent			

The first stage of the model focuses on the goals of the organization. As Finney and Lesieur (1982:269) note, "...one of the key ideas for understanding organizational crime is that formal organizations, by their very nature, are strongly goal-oriented and concerned with performance." Since all organizations are justified and evaluated in terms of their success or failure in goal attainment, an analysis of organizational behavior (of any kind) must focus on the concept of organizational goals and the "performance emphasis" (Gross, 1978) that exists within the organization. Even though there are a number of problems with this concept (Gross and Etzioni, 1985; Perrow, 1979), the analysis of organizational deviance must begin with an examination of the nature of organizational goals and their consequences.

Organizational goals are essentially abstractions that are distilled from the desires of members and from environmental and internal pressures. Perrow (1961) argues that these abstract values must be translated into more specific directives, in order for the organization to act. He distinguishes between "official" and "operative" organizational goals. According to Perrow (1961:855), official goals are "... the general purposes of the organization as put forth in the charter, annual reports, public statements and other authoritative pronouncements". On the other hand, operative goals "... designate the ends sought through the actual operating policies of the organization; they tell us what the organization actually is trying to do regardless of what the official goals say are the aims (Perrow, 1961:855).

Assuming that we can discover the operative goals of an organization, how do these organizational goals influence deviant organizational acts? To understand this process we need to move to stage two of the model which focuses on the constraints or operating strains that organizations encounter as they attempt to achieve operative goals. To achieve its goals an organization must utilize available means or resources in an effective and efficient manner. The available means may be legitimate, that is normative, or illegitimate and deviant. If an organization is unable to achieve its operative goals through legitimate means, it may seek to achieve those goals through illegitimate or deviant means.

The disjunction between organizational goals and legitimate means creates a structural strain which the organization must resolve (McKay, 1938). The organization could, of course, reduce the strain by abandoning or re-evaluating its operative goals. But the organization can also adapt to structural strain by resorting to deviant means. And given the performance emphasis, both

external and internal to most organizations, it is argued that organizations are far more likely to reduce structural strain and achieve organizational goals through means which are unethical, deviant, or criminal. Gross (1978:57) argues that organizations are inherently criminogenic because of the possibility of structural strain:

> As arrangements which are committed to goal attainment or performance, organizations will often find themselves in difficulties. They live in competitive environments, even in socialist society, in which there are always insecurities, and uncertainties in supplies, money, sales, and security support... Given a situation of uncertainty in attaining goals, and one in which the organization is judged (directly, or indirectly by sales or other indicators) by its success in goal attainment or performance, one can predict that the organization will, if it must, engage in criminal behavior to attain these goals.

Not all organizations that experience this structural strain, however, engage in deviant acts. To understand why some do and some do not, we need to move to the third stage of the model. The third stage highlights the importance of social control mechanisms, both internal and external to the organization. As Finney and Lesieur (1982: 275) point out: "Whether or not a strong performance orientation and operating problems lead to crime depends also on the operationality of various social controls". Even though a condition of structural strain may pressure an organization and its agents toward a deviant solution to the problem that confronts them, there may be a variety of controls that will operate to block or reverse deviant actions.

These three elements - operative goals, structural strain, and the operationality of controls - constitute the heart of a theoretical model on organizational crime. This model, however, needs to be fleshed out more by examining the operation of these elements at two analytically distinct organizational levels.

The first level to be examined is the intersection of the environment and the organization. The primary concern of this level is with the influence of the organization's larger environment on the internal structure of the organization. Formal organizations, such as NASA, always operate within a complex socio-cultural environment. Organizational decisions and actions are shaped significantly by the external environment. As Aldrich (1979:1) has noted: "Many questions of interest to organizational sociologists today require a perspective on organizations that takes account not only of the internal structure of organizations but also the forces in their environments that set limits to organizational discretion."

The environment of an organization consists of any and all elements external to the organization, be they economic, political, cultural, technological, or interorganizational. Environmental elements influence organizational behavior not only directly but also indirectly through their impact on the internal structure and goals of the organization. Thus, the environment shapes the operative goals of the organization, the structural strains it may experience, and the external control mechanisms it may face.

The second level of the model focuses on the intersection of the structure of the organization and the individuals who occupy positions within that structure. The primary concern at this level is with the internal structure of the organization and the way it shapes and sets limits on the decisions and actions of the individuals who make up the organization. By organizational structure, sociologists usually mean "...the distributions, along various lines, of people among social positions that influence the role relations among these people" (Blau, 1974). The structure of an organization, therefore, refers to

such things as the division of labor, the hierarchy of authority, the communication system, and the normative order. Organizational structure, according to Hall (1977:102) serves two basic functions:

> First, structures are designed to minimize or at least regulate the influence of individual variations on the organization. Structure is imposed to ensure that individuals conform to the requirements of the organization and not vice versa. Second, structure is the setting in which power is exercises (structure also sets or determines which positions have power in the first place), in which decisions are made (the flow of information which goes into a decision is largely determined by structure), and in which the organization's activities are carried out.

The internal structure of the organization is important at all three stages of the model. First of all, the internal structure has a significant impact on the operative goals of the organization. The structure helps to shape the more general goals and translates these into more specific subgoals for different units within the organization. As Stone (1975) points out, these subgoals define the task environment of the people who do the actual work within the organization. Thus, the structure defines specific task goals for individuals and exerts an enormous pressure on them to attain these goals.

Second, the internal structure may generate structural strains within the organizations that pressure individuals to consider using illegitimate means to achieve operative goals. A resource structure that causes operating strains, problems of coordination, control and communication, the complexity of the structure, authority leakage, the erosion of norms supporting legitimate actions, all of these and a number of other internal problems may produce structural strain which results in deviant organizational actions.

Finally, the internal structure may or may not contain social control mechanisms that will block deviant acts by the organization. The existence of such mechanisms greatly reduces the chances of organizational misconduct. The internal structure, however, may also contain a number of elements that make it easy for individuals within the organization to abdicate their own personal responsibility for deviant organizational acts. The instrumental rationality of the organizational form, role specialization leading to a diffusion of responsibility, the development of rationalizations and techniques of guilt neutralization, the group think syndrome and punitive sanctions, are all factors within the organization that can lead to the abdication of personal responsibility.

The Space Shuttle Disaster: A Case Study of Organizational Deviance

Although the technical cause of the explosion of the Space Shuttle Challenger was the failure of the pressure seal in the aft field joint of the right solid rocket motor, the flawed decision-making process at NASA was the more important cause. This conclusion is substantiated by the findings of the Presidential Commission on the Space Shuttle Challenger Accident. The Roger's Commission (1986:104) found the following:

1. ...there was a serious flaw in the decision-making process leading up to the launch of flight 51-L (the Challenger flight). A well structured and managed system emphasizing safety would have flagged the rising doubts about the Solid Rocket Booster joint seal. Had these matters been clearly stated and emphasized in the flight readiness process in terms reflecting the views of most of the Thiokol engineers and at least some of the Marshall engineers, it seems likely that the launch of 51-L might not have occurred when it did.

2. The waiving of launch constraints appears to have been at the expense of flight safety. There was no system which made it imperative that launch constraints and waivers of launch constraints be considered by all levels of management.

3. The Commission is troubled by what appears to be a propensity of management at Marshall to contain potentially serious problems and to attempt to resolve them internally rather than communicate them forward.

From the findings of the Roger's Commission, and the reactions of the public, Congress and the media, it seems clear that the space shuttle disaster was a form of organizational deviance. The purpose of this section is to use the theoretical model developed in the previous section to help us understand the organizational deviance of NASA in this case. We will proceed by examining each stage of the model as it applies to NASA at the two different organizational levels.

Stage 1: Operative Goals of NASA

The first step in understanding the space shuttle disaster is to discover the operative goals of NASA. We will examine these goals at two levels. First, we will look at the way in which the broader political and economic environment shaped NASA's goals concerning the space shuttle. As we analyze these environmental pressures, we will observe how specific goals were internalized within the structure of NASA and the performance pressure these goals exerted in turn on agency officials.

To start, we need to briefly review the history of the space shuttle and the political decisions made about it. The idea of a reusable spacecraft that could provide frequent, economical access to space first surfaced in the late 1960s during the height of the Appolo program. In September, 1969, a Space Task Force report to the President offered a choice of three long range plans. In varying combinations these plans called for: 1) a manned Mars expedition, 2) a

lunar orbiting space station, 3) an earth orbiting station, and 4) the space shuttle to link the orbiting station to earth (Space Task Group Report to the President, 1969)

In March, 1970, President Nixon made an important political choice. For budgetary reasons he scrapped the Mars project and the space platform, but ordered the development of the shuttle vehicle. As the Roger's Commission (1986:2) pointed out: "Thus, the reusable Space Shuttle, earlier considered only the transport element of a broad, multi-objective space plan, became the focus of NASA's near term future."

This decision forced NASA to put all of its eggs in one basket, so to speak, and shaped significantly NASA's goals for the future. From this point on, NASA would try to prove that the shuttle could be used as a universal launch vehicle. Enormous pressure developed to create an operational shuttle system and begin a heavy schedule of flights. As the Roger's Commission (1986:201) noted: "The nation's reliance on the Shuttle as its principal space launch capability created a relentless pressure on NASA to increase the flight rate."

The pressure on NASA to make the space shuttle a universal launch vehicle increased dramatically in the 1980s under the Reagan Administration. There were three elements involved in this high pressure system. First, there was pressure to declare the space shuttle "operational" and no longer "developmental" in the early 1980s. Second, there was pressure to make the shuttle system an economically self-sufficient commercial cargo hauler. Finally, the Reagan Administration increasingly expected the space shuttle to play a major role in the military space program. Each of these will be considered in turn.

Ronald Reagan came into office just as the space shuttle program was preparing to launch its first test flight. In August of 1981, the President established an interagency review of U.S. space policy chaired by Dr. George Keyworth, then the President's science advisor. The Keyworth group's deliberations took place as NASA completed the first four orbital test flights. The result of these deliberations was the "Presidential Directive on National Space Policy". This directive was issued in conjunction with Reagan's first major speech on space, delivered at Edwards Air Force Base on July 4, 1982, the day the initial orbital tests concluded.

In this directive and speech, Reagan announced a national policy to set the direction of the U.S. space program during the following decade. As part of that policy, the President stated that the shuttle system, "...is the primary space launch system for both national security and civil government missions" (Roger's Commission, 1986:164). Reagan went on to declare the space shuttle fully operational and thus, ready for a wide variety of important tasks:

> The fourth landing of the Columbia is the historical equivalent to the driving of the gold spike which completed the first transcontinental railroad. It marks our entrance into a new era. The test flights are over, the groundwork has been laid, now we will move forward to capitalize on the tremendous potential offered by the ultimate frontier of space. Beginning with the next flight, the Columbia and her sister ships will be fully operational and ready to provide economical and routine access to space for scientific exploration, commercial ventures, and for tasks related to the national security. Simultaneously, we must look aggressively to the future by demonstrating the potential of the shuttle and establishing a more permanent presence in space (quoted in Heaphy, 1986:3).

The President's declaration that the space shuttle was "fully operational": exerted enormous pressure on NASA. An operational system is one that has moved out of the research and development phase into routine operation. Problems and mistakes are expected and looked for in the development phase but are not

expected and looked for in the operational phase. By the time something is operational, the bugs in the system are supposed to be worked out. Yet, was this true of the shuttle system? It was not, according to a number of experts. They argue that the system was still in the research and development phase and that the President prematurely labeled it operational. This led to a relentless pressure on NASA to launch shuttle missions on an accelerated schedule. As Jim Heaphy (1986:3) editor of Space For All People, points out: "After the President had so promptly and vigorously declared the shuttle fully operational, the atmosphere at NASA was no longer conducive to sober and rational assessment of the underfunded spacecraft's short-comings". And, as John Pike, associate director for space policy with the American Federation of American Scientists, commenting on the launch pressure on NASA has observed: "I point the finger at the Administration. They were clearly declaring the thing operational before it was operational, and that's something that has taken place entirely under the Reagan Administration" (Heaphy, 1986:3).

The Reagan Administration was eager for the shuttle system to become operational because they had developed some rather ambitious commercial and military goals for NASA to achieve. One of these goals was for NASA to become an economically self-sufficient cargo hauler, primarily of communication satellites. As the Detroit Free Press (1986:10a) noted: "In recent years ... top NASA officials found themselves under pressure to prove that the immense cost of space exploration could be at least partially justified by commercial use of the agency's technology". Thus, NASA found itself in the business of launching satellites for a wide variety of customers.

This business, in turn, generated further launch pressures and a competitive need to advertise the shuttle system as operational. In the first place, NASA had to compete with the European Space Agency's Ariane satellite launcher for customers and, therefore, "...had to make its shuttle missions look routine and dependable" (The Nation, 1986:164). But, the launching of commercial satellites also introduces new schedule problems and a demand for an increased flight rate that only an operational system could meet. As David Sanger (1986:22) of the New York Times noted:

> For as long as the space shuttle program remains primarily a cargo ship rather than a research vehicle ... NASA will find itself under pressure to stay on schedule and stay competitive. Those pressures were ... the result of overly ambitious flight schedules developed by space agency officials bent on proving to Congress potential shuttle customers that the vehicle was "operational".

And, as the Roger's Commission (1986:165) itself pointed out:

> Pressures developed because of the need to meet customer commitments, which translated into a requirement to launch a certain number of flights per year and to launch them on time. Such considerations may occasionally have obscured engineering concerns. Managers may have forgotten - partly because of past success, partly because of their own well-nurtured image of the program - that the Shuttle was still in a research and development phase.

In addition to these commercial concerns, NASA was increasingly asked to use the space shuttle for military purposes as well. From the very beginning, NASA was, for the United States, an important element in the science-technology race that takes place within the context of military objectives and interests (Nieburg, 1966). As the shuttle system came to be the centerpiece of the space agency's projects, pressure for the militarization of its missions, from the Congress, the Pentagon, and the White House, became more frequent. As The Nation (1986:164) has pointed out: "To win funding from Congress, NASA had to

jump into bed with the Air Force, which demanded fundamental changes in the civilian agency's concept of a reusable spacecraft to accommodate military cargoes."

The pressure on NASA to use the shuttle system to accomplish military goals also increased dramatically under the Reagan Administration. The Administration was eager to declare the space shuttle operational because it had a number of "tasks related to the national security" that it wanted carried out. In the Presidential Directive on National Space Policy" issued in 1982, NASA was instructed to "preserve United States preeminence in critical space activities". Keeping the space shuttle on an accelerated flight schedule was described as "vital and critical" to the national defense. The directive went on to say that, "launch priority will be provided for national security missions" (Heaphy, 1986:3). Pressures on the shuttle program escalated even more the next year with the announcement of Reagan's "Star Wars" plan. Whatever form the Strategic Defense Initiative would eventually take, the testing and development of such a space missile defense system would require an operational space shuttle capable of making a very large number of flights on a regular schedule.

As this section demonstrates, NASA's organizational goals concerning the shuttle program were significantly shaped by the external environment of the organization. Political and economic forces outside the agency pressured NASA to declare the space shuttle "operational", and take on a variety of commercial and military goals. These goals were taken on willingly and enthusiastically by NASA. Because of political decisions made in the early 1970s, and since the end of the Apollo program, the shuttle system was, for all practical purposes, the

only game in town for NASA. The agency, it is clear, was bound and determined to prove to all of those in its external environment, that the shuttle was operational and could be used as a universal launching vehicle.

These goals were internalized within the organizational structure of NASA. The agency thus committed itself to a frenetic pace of launchings in the 1980s, at one point proposing 714 flights between 1978 and 1990 (The Nation, 1986:164). The commitment to the commercial and military goals described above led to "unrelenting pressure to meet the demands of an accelerating flight schedule" (Roger's Commission, 1986:152). This pressure was undoubtedly felt by the individuals who occupied positions within the organizational structure at NASA. It was this launch pressure which would lead to Solid Rocket Booster Project Manager Lawrence Mulloy's comment, upon hearing of objections to the 51-L launch by the Morton Thiokol engineers, "My God, Thiokol, when do you want me to launch, next April?" It was this unrelenting pressure to launch, generated by the external environment, internalized within the structure of NASA, and focused on the individual decision makers within NASA, that set the stage for the Challenger disaster.

Stage 2: Structural Strains Within NASA

As NASA attempted to meet the increasing flight schedule of the space shuttle and achieve the commercial and military goals that had been laid out for it, the agency encountered a number of constraints and operating problems. These constraints made it increasingly difficult for NASA to reach its goals in a legitimate way, that is, with the high level of safety almost everyone expected of it. The disjunction between the organizational goals of NASA and the legitimate or safe means available to meet these goals, created structural strains within the agency. NASA attempted to resolve these strains by

increasingly resorting to means which were less safe, rather than reduce the strain by lowering its goals and reducing the flight rate. To understand NASA's decision to use deviant means to achieve organizational goals, we must understand the constraints and operating problems that generated the structural strains in the first place.

Structural strains were introduced into the shuttle program from a wide variety of sources. No one source of strain was entirely responsible for the Challenger disaster. Among the sources of strain external to NASA were: 1) the faulty design of the joint of the right solid rocket motor by the contractor, 2) bad weather, and 3) engineering data from the engineers at Morton Thiokol. Each of these will be considered in turn.

The first source of structural strain directly related to the Challenger disaster was the faulty seal design of the joint on the solid rocket motor. The faulty design, of course, was the responsibility of Morton Thiokol, the contractor for the solid rocket motors. As we will see, Morton Thiokol can also be regarded as a deviant organizational actor due to this design flaw and later actions on the night before the explosion of the Challenger. The Roger's Commission (1986:148), however, blamed both NASA and the contractor for the flawed design and the failure to act on information concerning this flaw:

> The genesis of the Challenger accident - the failure of the joint of the right Solid Rocket Motor - began with decisions made in the design of the joint and in the failure by both Thiokol and NASA's Solid Rocket Booster project office to understand and respond to facts obtained during testing. The Commission has concluded that neither Thiokol nor NASA responded adequately to internal warnings about the faulty seal design. Furthermore, Thiokol and NASA did not make a timely attempt to develop and verify a new seal after the initial design was shown to be deficient.

Information concerning the faulty seal design was a source of structural strain within NASA. If the design was flawed and, therefore, unsafe, it should have been redesigned and made safe. To do this, however, would have greatly slowed down the space shuttle's flight schedule. Because of the enormous environmental pressures on NASA, a long delay was to be avoided at all costs. As Heaphy (1986:3) has noted: "An environment had been created where anyone calling for a halt to the shuttle program for a safety design was opening themselves up to a charge of advocating economic collapse, nuclear destruction and communist control of Mars."

How did NASA resolve this strain? NASA officials responded by keeping the space shuttle flying, and at an accelerated schedule at that. The problems with the faulty seal design were defined as "not serious" and as an unavoidable and acceptable "flight risk". Enough concern about the problem had been raised at the highest levels within NASA, however, so that the agency quietly began to embark on a program to solve the problem of the leaky booster rocket seals (Broad, 1986a). This shuttle seal remedy was to be systematically applied to the entire space shuttle fleet, but the redesign was not yet available for the Challenger flight of January 28, 1986. Thus, while NASA worked on solving the problem it continued to fly and defined the risk as "acceptable" and "unavoidable". As Dr. Alex Roland, a former NASA official put it (Broad, 1986b:21):

> They had put the whole future of the space program on the shuttle. There was no way out. Overwhelming problems were just denied. It wasn't conscious deception. They were kidding themselves as much as anybody else.

NASA continued to fly and continued to define away the escalating risks. The agency continued to use unsafe means to attain its ambitious goals because, as the Roger's Commission (1986:148) noted, they "got away with it last time". As Commissioner Richard Feynman (Roger's Commission, 1986:148) observed, the decision making was:

> a kind of Russian roulette... (the Shuttle flies with O-ring erosion) and nothing happens. Then it is suggested, therefore, that the risk is no longer so high for the next flights. We can lower our standards a little bit because we got away with it last time... You got away with it, but it shouldn't be done over and over again like that.

In addition to the general structural strain caused by the faulty seal design, there were two other external sources of strain that related to the flight of the Challenger on January 28, 1986. One was the weather and the other was engineering data NASA received from Thiokol engineers on the night of January 27. The weather, of course, is generally a source of strain concerning NASA launchings and landings. Bad weather of one kind or another can make it unsafe to fly. NASA has frequently decided to delay flights because of unacceptable weather conditions. Strains due to weather, therefore, are generally resolved in favor of safety and NASA accepts these short flight delays. Flight 51-L had already been postponed once and delayed once due to weather conditions.

The weather on the night of January 27, 1986 caused a different type of strain at NASA, and this strain was directly connected to information Thiokol engineers were providing to certain NASA officials that night. Several Thiokol engineers voiced objections to the launch of 51-L when they found out about the unusually cold temperature predicted for launch time the next morning. They were concerned about the detrimental effect such cold temperatures could have on

the performance of the solid rocket motor joint seal, the same seal that had already generated strain at NASA. During the afternoon of January 27, Thiokol engineers presented their concerns about the cold temperatures to level III officials in the NASA readiness review process and recommended that the launch be delayed again.

These engineering concerns produced another structural strain within NASA. Flight 51-L had already been postponed three times and delayed once. Given the launch pressure described above, agency officials did not want to fall further behind schedule. Yet, the Thiokol engineers were saying it was not safe to fly at temperatures lower than 53°F, and they would not give the required launch recommendation. How was this strain to be resolved?

NASA officials at level III of the readiness review were committed to launch. Another delay was unthinkable. It was at this point that Lawrence Mulloy made his, "My God, Thiokol, when do you want me to launch, next April?, comment. At a teleconference between NASA and Thiokol officials, pressure was brought to bear on the Thiokol engineers to reverse their no launch recommendation. Management officials at Thiokol also put pressure on their engineers. One Thiokol official was told to take off his engineering hat (and presumably his concern for safety) and put on his management hat (and his concern for organizational goals). Eventually, the management at Thiokol, over the objections of some of its own engineers, gave the required recommendation for launch. The level III NASA officials did not communicate the engineering concerns about the effect of cold weather on the joint seals to Levels I and II despite the earlier problems with these seals, and also recommended that the Challenger fly the next morning. As the Roger's Commission (1986:82) observed:

> The decision to launch the Challenger was flawed. Those who made that decision were unaware of the recent history of problems concerning the O-rings and the joint and were unaware of the initial written recommendation of the contractor advising against the launch at temperatures below 53 degrees Fahrenheit and the continuing opposition of the engineers at Thiokol after the management reversed its position... If the decision makers had known all of the facts, it is highly unlikely that they would have decided to launch 51-L on January 28, 1986.

The cold weather caused a structural strain for the level III officials at NASA. They were committed to a launch but were presented with engineering data that told them they did not have the safe means to accomplish the task. Rather than change the goal and delay the flight, these men resolved the strain by using deviant means, that is, lower safety standards than were acceptable. This resolution to the strain is illustrated very well by the comments of two Thiokol officials to the Roger's Commission. Both Mr. Boisjoly, the engineer, and Mr. Lund, the manager, point out the different mode of thinking about safety that occurred the night of January 27, 1986.

> Mr. Boisjoly: One of my colleagues that was in the meeting summed it up best. This was a meeting where the determination was to launch, and it was up to us to prove beyond a shadow of a doubt that it was not safe to do so. This is in total reverse to what the usual is in a preflight conversation or a flight readiness review. It is usually exactly opposite that (Roger's Commission, 1986:93).
>
> Mr. Lund: But that evening I guess I had never had those kinds of things come from the people at Marshall. We had to prove to them that we weren't ready, and so we got ourselves in the thought process that we were trying to find some way to prove to them it wouldn't work, and we were unable to do that. We couldn't prove absolutely that the motor wouldn't work.
>
> Chairman Rodgers: In other words, you honestly believed that you had a duty to prove that it would not work?
>
> Mr. Lund: Well, that is kind of the mode we got ourselves into that evening. It seems like we have always been in the opposite mode. I should have detected that, but I did not, but the roles kind of switched.

Stage 3: The Operationality of Controls at NASA

Given the strong performance emphasis at NASA, it is easy to see how these structural strains pushed the agency toward deviant acts in the case of the Challenger disaster. These strains, however, could pressure the organization to adopt deviant solutions to its operating problems only because of the absence of social control mechanisms at NASA. Adequate control mechanisms both external and internal to the space agency could have prevented the tragedy of flight 51-L. To fully understand this disaster we need to examine the circumstances surrounding the absence of social controls at NASA.

One thing that has emerged quite clearly out of the various investigations of the space shuttle program, is the fact that NASA has not been subjected to any strong oversight by an external control agency. Most organizations, public or private, are subjected to a variety of social control mechanisms in their external environment. Corporations, for example, are subject to the criminal justice system, a wide variety of regulatory agencies, the media, labor unions, consumer groups, and public opinion. These external controls may be quite weak, but their sheer numbers guarantee at least a modest measure of oversight.

Governmental agencies like NASA are subjected to far fewer controls. Congress serves as the primary control agent for these organizations, with the media and public opinion in the environment as well. Of all government agencies, NASA has received a virtually free ride in terms of oversight and control. This is especially true of Congressional oversight of the agency. As Representative Robert Roe of the House Committee on Science and Technology recently observed: "Congress has been too shy in finding fault with NASA. As the result of the challenger accident, Congress and NASA must begin a new era, one in which Congress must apply the same strong oversight to NASA that it does

to any other government agency" (Benedict, 1986:4a). And, as Representative Manual Lujan, the senior Republican on the Science and Technology Committee, has confessed: "As a committee, we may have been too trusting when NASA gave us glowing reports about the space shuttle program" (Benedict, 1986:4a).

The Congress, of course, is in a position not only to exercise oversight and control, but also to help shape NASA's operative goals and relieve structural strains through the provision of greater resources. But for that to happen, the cozy and uncritical relationship Congress has with NASA needs to change.

As with Congressional oversight, NASA has generally been given favorable treatment in the media and been held in high esteem by the public. The excitement and romance of space travel, its high entertainment value, and the genuine successes of NASA, have all combined to produce public approval of the space agency and its worshipful treatment by the media, especially television. A more sober, objective and critical stance on the part of the public and the media may be able to exert some counterbalancing pressures on NASA.

Not only was there an absence of external social control over NASA, there were no adequate internal control mechanisms to prevent the shuttle disaster either. Within the organizational structure of NASA there were three major social control problems: 1) the failure of the communication system, 2) the reduction of the safety program and the lack of independence for safety personnel, and 3) the erosion of norms of safety within the internal culture.

The first major social control problem within the organizational structure at NASA was the absence of an effective communication system. A strong communication system is essential to handle the problems of coordination and control. Without effective vertical and horizontal communication, top management may

experience authority leakage and lose control over subunits within the organization. According to the Roger's Commission (1986:82), "...failures in communication that resulted in a decision to launch 51-L based on incomplete and sometimes misleading information," was a contributing cause of the shuttle disaster.

The testimony of Arnold Aldrich, the National Space Transportation System Program Manager, pinpoints two crucial ways in which the communication system within NASA failed to control the impending deviance within the space agency (Roger's Commission, 1986:101-102):

> Dr. Feynman: ...have you collected your thoughts yet on what you think is the cause - I wouldn't call it of the accident but the lack of communication which we have seen and which everybody is worried about from one level to another?...
>
> Mr. Aldrich: Well, there were two specific breakdowns at least, in my impression, about the situation. One is the situation that occurred the night before the launch and leading up to the launch where there was a significant review ... and the fact that that was not passed forward...
>
> Mr. Aldrich: The second breakdown in communications, however, and the one that I personally am concerned about is the situation of the variety of reviews that were conducted last summer between the NASA Headquarters Organization and the Marshall Organization on the same technical area and the fact that that was not brought through my office in either direction...

Of course, it is not clear if the forwarding of the general concern over the joint seals or the specific concerns of the Thiokol engineers would have made any difference. The officials who were to receive this information may not have wanted to hear it and they may have actually discouraged such bad news from coming to them. And, if they had received the information, would they have acted differently? We cannot know for sure if they would have delayed the flight of 51-L or ordered a halt to the program for a major safety redesign.

The general point here is that the more such bad news is communicated and shared within an organization, the greater the possibility of control over deviant decisions. In fact, the tendency at Marshall to management isolation was cited by the Roger's Commission as a major factor in the breakdown of communications at NASA. This is ironic since the Marshall Space Center in the 1960s was lauded as having an extremely communications conscious management (Thompkins, 1977; 1978).

The second internal social control problem was the reduction in the safety program at NASA and the lack of independence for those safety personnel that did remain. In its report, the Roger's Commission devotes an entire chapter to what it calls the silent safety program at NASA. They found that the safety, reliability, and quality assurance work force at NASA had been reduced, and that this reduction had seriously limited NASA's capability in these vital functions which, in turn, adversely affected mission safety. As the Commission (1986:152) noted:

> The unrelenting pressure to meet the demands of an accelerating flight schedule might have been adequately handled by NASA if it had insisted upon the exactingly thorough procedures that were its hallmark during the Apollo program. An extensive and redundant safety program comprising interdependent safety, reliability and quality assurance functions existed during and after the lunar program to discover any potential safety problems. Between that period and 1986, however, the program became ineffective. This loss of effectiveness seriously degraded the checks and balances essential for maintaining flight safety.

While there has been a reduction in the overall safety program at NASA, there still remains a myriad of safety, reliability and quality assurance units within the overall structure. The ability of these units to act as social control mechanisms, however, is seriously eroded by their lack of independence within the overall structure. The ability of these units to act as social control mechanisms, however, is seriously eroded by their lack of independence

within the structure. Both Kennedy and Marshall have placed safety personnel under the supervision of the very offices and activities whose efforts they are to check and control. This structural flaw was described well by the Roger's Commission (1986:153):

> In most cases, these organizations report to supervisors who are responsible for processing. The clear implication of such a management structure is that it fails to provide the kind of independent role necessary for flight safety. At Marshall, the director of Reliability and Quality Assurance reports to the director of Science and Engineering who oversees the development of shuttle hardware. Again, this results in a lack of independence from the producer of hardware and is compounded by reductions in manpower, the net bringing about a decrease in effectiveness which has direct implications for flight safety.

The final social control problem within the internal structure at NASA was the erosion of norms supporting the use of legitimate means to accomplish organizational goals. An internal culture had developed in which safety and technical considerations were often downplayed. As Eyles (1986) and Thompkins (1977; 1978) point out, the normative environment at NASA was quite different during the Apollo era. The erosion of normative supports for the safest possible means to carry out the agency's missions removed one of the strongest social control mechanisms that can exist within an organization.

General Ethical Observations

1. Effects

The effects of one's actions, communication, or failure to communicate are often assessed as one means of making ethical judgments. The deaths of seven astronauts, the ill-effects on their families and friends, the harm done to the space program, to national pride and to the psyche of the American public, the harm done to persons associated with the space program, and the political repercussions were all a part of disastrous consequences which resulted from the

space shuttle disaster. "Historians," says Lecky, "will probably always judge men and policies by their net results, by their final consequences" (Thonssen and Baird, 1948:448). Brembeck and Howell (1952) translate this into a consequentialist or social utility principle of one's communication (or lack of) in judging one's ethics. Clearly, the failure to communicate as well as the presentation of misleading information was a major cause of the space shuttle disaster and the ill-effects which resulted, and, thus, must be criticized from this ethical perspective.

2. Decision-making processes

Persons who accept major decision-making roles must be held to standards which represent careful, rational, objective, and caring decision-making processes. The lives and careers of many persons are dependent upon persons in authority and thus, they have special moral and ethical obligations. The decision-making processes in the space shuttle disaster were, at best, flawed. Not only were NASA's own standards violated, but the standards of communication specialists were violated. The communication field and other disciplines have long-established methodology for good decision-making and have clearly identified many of the traps. Janis (1982), for example, has explained how the group-think syndrome has contributed to bad decision-making. Decision-makers at the executive level of space flight technology should have learned from examples derived from historical fiascos, such as the experience of John F. Kennedy's cabinet in the ill-fated "Bay of Pigs" decision and the improvements which were made in group process during the "Cuban Missile Crisis" (Janis, 1982:195 & 273). The failure of NASA decision-makers to utilize principles of existing effective decision-making processes must be criticized. They violated their own standards and the standards of decision-making specialists as well.

3. Process of Communication

Other processes of effective communication were deficient in the NASA organization. Information flow was limited and barriers existed which would not permit a free and open exchange of information. The responsibility of assuring that information will flow in an organization is largely that of top management. Management should be held to similar stringent standards of effective communication in an organization as they are held to exacting standards of technical design and performance. Thus, competence in effective communication is an important responsibility for managers (Bales, 1981:75-76).

An open and supportive communication climate could have made it possible for the Thiokol's engineers concern about the O-Rings deficiencies to have been widely known throughout the organization, and the disaster would have been averted. Management at Levels I and II in NASA indicated that they would not have launched on January 28, 1986 had they known of the O-Rings problems. However, management teams should have been aware that bad news seldom flows up an organization, a basic finding in organizational communication (Rogers & Rogers, 1976). Thus, top management must devise special methodologies to correct this problem. Ironically, it was the Marshall Space Flight Agency which was cited by Phillip Tompkins to have a particularly unique communication system (in the early stages of the agency). Tompkins tells of Werner Von Braun's use of "Monday's Notes" in order to help him to find out what was happening throughout the organization. Von Braun asked department heads to write a one-page memo each week regarding progress, problems, and the like. They were to arrive on Von Braun's desk each Monday morning. In turn, he would read the memos, write comments in the margins, and send duplicated copies of the memos (including his notes) back to all department heads. Not only was Von

Braun informed, but department heads were also informed as to what was happening in other departments (horizontal communication) and they knew Von Braun's reactions. A very important additional advantage of this simple system was that persons throughout the organizations were made aware of the chief executive officer's values, moral and ethical standards, and goals. This system promoted openness and exchange of information throughout the organization (Tompkins, 1977:1-26).

The failure of NASA managers to encourage free and open communication in the system was a failure which has ethical implications. It was their responsibility to devise a communication system which worked and for them to model good communication. The fact that they were hardly competent in this area is seen as an ethical fault.

4. Human element: Risks to the astronauts

An ethic of "care" mandates that persons in positions of authority be concerned about the effects of actions on human beings. Testimony in the Roger's Commission Report suggests that little communication revolved around the possible fate of the astronauts. The fact that the astronauts' lives were at stake presents a burden which did not seem to be adequately accepted, especially by the Thiokol and Marshall managers. It is very troublesome that the astronauts were never told of the risks they faced.

5. Moral and Ethical Conscience

One of the goals of ethicists is to increase the sensitivity and awareness of persons to potential ethical issues. Ethical issues are frequently implicit. Ethical issues were seldom, if ever, discussed, if the testimony in the Roger's Commission Report is a reasonable record of the communication which took place. Ethical issues need to be explicitly identified and discussed from

a variety of perspectives. Rights of persons, freedom of expression, truthfulness, moral and ethical responsibilities, means and ends needed to have been a part of NASA's considerations. It appears that decision-makers did not discuss the moral and ethical implications of their actions.

6. Whistleblowing and communication by-passing

Either whistleblowing or by-passing the usual channels of communication could have been effectively prevented the January 28, 1986 launch. This puts a heavy weight of responsibility on those persons who did not speak out. Indeed, the conditions in the space shuttle disaster presented engineers with a serious duty to speak out. Their understanding of the gravity of the situation surpassed that of management. We agree with Dave Lindorf (1986) that the Thiokol engineers had a duty to speak out, as difficult as it might have been. It is difficult for engineers to defend their choice not to pick up a telephone and inform persons in strategic positions of the problem with the O-Ring seal. Their preferred choice -- to obey authority, to maintain their own secure position in the organization, and to maintain a stable organizational infrastructure -- is hard to defend. A morally preferred position would have been for the engineers to blow the whistle or to by-pass internal channels of communication, being aware of the propensity of NASA management to "put on the management hat" and to make decisions on an economic cost benefit ratio. "The shuttle explosion is 'another example of the accelerating degradation of the status of the engineer in the American corporation,' says Ralph Nader (Lindorf, 1986:880). 'The profit motive is overriding engineering concerns at exactly the time when engineers' views are becoming crucially important. What happened (at

NASA and Morton Thiokol) is instructive: not only were the engineers overruled by management; they were so afraid of retaliation that they didn't go outside the chain of command'" (Lindorf, 1986:880).

It must be noted, however, that the engineers at Morton Thiokol are to be commended for arguing their position forcefully within their corporation. Their acceptance of personal responsibility apparently stopped there. That was a critical error.

SUMMARY

In summary, the moral and ethical culpability of various individuals and of the NASA organization and its subsidiaries is considerable. We base this on six ethical observations: (1) The effects of the ill-fated launch were disastrous; (2) The decision-making processes failed to meet the standards of NASA or of communication specialists; (3) The process of communication, by design and by practice, was faulty; (4) Risks and the respect for the lives of the astronauts were compromised; (5) Participants in the decision-making process failed to consider moral and ethical implications of their actions; (6) Engineers did not blow the whistle or by-pass prescribed channels in order to alert others of the potential disaster.

These problems need to be corrected. We have offered several possible directions in our analysis of both the ethical issues and organizational problems.

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